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(12) # EUROPEAN PATENT SPECIFICATION

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(54) **A method of shielding a printed circuit board, or a part of it, from disturbances caused by electromagnetic interference, and a shielding housing to be used in the method.**

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DE-A- 2 148 568
DE-A- 3 402 714
DE-B- 1 276 766
US-A- 4 816 612

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Descripti n

The pr sent invention relates to a method of shielding a printed circuit board, or a part of it, from disturbances caus d by electromagnetic int rfer nce (EMI), th printed circuit board or its part being nclosed in a shielding housing which comprises a cover part with adjoining side parts. The invention also relates to a shielding housing for use in the method.

It is known that in electronic equipment in which the packing density of components and the frequencies used are relatively high there is the problem of electromagnetic coupling between different functional circuits. This coupling, i.e. electromagnetic interference (EMI), causes disturbances in the functioning of the circuits. The circuits have to be shielded in order to prevent this coupling. High requirements are set on the shielding methods with respect to shielding effect, space requirement of the shield, its weight, price, usability for shielding parts of a printed circuit, and the detaching and attaching properties of the shield.

It is well known in the art to place the entire electric circuit to be shielded in a metal shielding housing, from which signals travel via interference-shielded connectors to other circuits. However, such a solution is space-consuming and increases the weight of the device, being poorly applicable when on the same printed circuit board there are several areas to be shielded separately.

It is also known to shield certain parts on a printed circuit board with various metal shielding covers. In such a case, various methods are used: a housing with a cover and side walls is placed on the printed circuit. At the lower edges of the side walls there are tabs which, during the installation of the housing, pass into apertures in the printed circuit board and are bent on the other side of the board into an orientation parallel to the lower surface of the board, thus securing the housing firmly to the board. For purposes of maintenance of the printed circuit the bent tabs are straightened out, whereupon the housing can be detached. Such a method is described in, for example the patent US-4,370,515. One method is to encase the circuit to be shielded in a metal wall, the lower edge of which is soldered to the printed circuit board. A cover is placed to bear on the wall, the edges of the cover being flexibly bent so that, when the cover is pressed over the wall, the flexible cover edges will produce a locking. These methods are highly usable when the lower surface of the printed circuit board is a continuous ground foil which serves as a shield on that side. However, the circuit board material used must be relatively thick in order to maintain the elastic property, and if the lower surface of the printed circuit board is not a continuous metal foil, arranging shielding on this side is cumbersome, and thus it is difficult to achieve a perfect shielding effect.

DE-A-3402714 discloses a shielding housing consisting of two cooperating sheet metal parts each of which covers one of two opposite sides of a printed circuit board, said parts having lateral U-shaped guiding grooves, whereby the edges of the printed circuit board are inserted into the guiding grooves of the first part which itself is inserted into the guiding grooves of the second part of the housing.

The present invention provides a solution by means of which a shielding housing is obtained which is easy and rapid to install and can be detached without soldering and to which it is easy to connect filters or feed-through-capacitors for connection of the shielded circuit to the rest of the environment. The shielding structure according to the invention is light in weight, and by means of it a part of a printed circuit can be shielded on all sides.

The method according to the invention is characterized in what is stated in Method Claim 6, and the shielding housing used in the method is defined in Claim 1.

In the method according to the invention, slots through the printed circuit board are cut at the manufacturing stage of the printed circuit board, on the edges of the circuit part to be shielded. The slots are cut starting from the edges of the printed circuit board and are extended so far that the area to be shielded is in its entirety left between them. Thereafter the components are attached to the printed circuit board. An end wall according to the invention is attached approximately between those end points of the slots which are farthest from the edges of the printed circuit board. Thereafter a shielding housing according to the invention is taken, which comprises a cover and three side walls with grooves inside. The distance of the cut slots from each other is the same as the mutual distance of the grooves on the opposite housing walls, the housing thus being capable of being pushed onto the printed circuit board so that the edges of the board between the slots push into the grooves inside the housing, whereupon the circuit area between the cut slots is left between the housing walls. When the pushing is continued, a bend in the upper part of the separate end wall attached to the printed circuit board pushes inside the housing and b comes locked to the housing cover. In the end wall there ar also small side flanges, which also push inside th housing, following its side walls. In this manner an EMI-shielding housing is obtained, which is easy to detach and to r -attach. Wh n it is desired to attach a shielding sheet also under th printed circuit board, it is easy to do so according to the inv ntion. When the grooves intended for th printed circuit board are made in th side walls of the shielding housing, the last bend, parallel to the printed circuit board surface, in th opposit walls is mad so long that th bends som what overlap and thus form

for the shielding housing a bottom which is left against the lower surface of the printed circuit board when the housing is pushed into th slots in the printed circuit board. Alt rnativ ly, a s parate bottom she t can b used which is placed to bear in th housing walls n the lower surface of the grooves intended for the printed circuit board. Thes low r surfac s are parallel t th printed circuit board surfac , and th bottom sheet in the installed position will be left, supported by these lower surfaces, against the lower surface of the printed circuit board.

The invention is described in greater detail with reference to the embodiments depicted in the accompanying drawings, in which

Figure 1 is a diagram of the principle of the shielding housing according to the invention and of its positioning on a printed circuit board,

Figures 2A-2C depict top and side views of the separate side wall of the shielding housing, and

Figure 3 is a cross section of a shielding housing installed on a printed circuit board.

The representation in Figure 1 illustrates the method of EMI shielding a part of a printed circuit board. Starting from the edges of the printed circuit board pc, slots U which go through the printed circuit board and have the length L are cut. The distance between the slots to be cut and their length L are determined by the area to be shielded. After the cutting of the grooves and the attaching of the electronic components, that part of the printed circuit pc to be protected is encased entirely or in part in a metal shielding housing. This shielding housing according to the invention is made up of two parts: end wall 2 and housing 1. The end wall 2 is an oblong piece the cross section of which is approximately a profile as shown in Figure 2 and which in this specification is referred to as a step-shaped profile. The housing 1 is made up of a cover 5 and of three profiled sides abutting it.

The structure of the end wall 2 is shown in greater detail in Figures 2 A-C. The profile has two approximately parallel flanges 12 and 13 and a center part 15 interconnecting them and forming one wall of the shielding housing in the final installation. The flanges 12 and 13 are oriented in opposite directions from the center part 15. At both ends of the oblong step-shaped profile piece 2 there are, in addition, end flanges 14, which narrow towards their ends and extend from the intermediate part 15 in the same direction as does the flange 13. The end wall 2 is attached to the printed circuit board by soldering the flange 12 to it, a number of apertures 17 having been punched in the flange 12 for the soldering tin. In order to align the end wall correctly to the printed circuit board pc, short tabs 18 can be formed at the end of the flange 12, the tabs being aligned with the alignment apertures drilled in the printed circuit board. In the other flange 13, a longitudinal groove or ridge 4 is formed. This groove or ridge is intended to engage the corresponding groove or ridge 3 in the cover 5 of the housing 1 at the end of the installing. To enable the shielded part of the printed circuit board to be connected electrically to the other circuits on the printed circuit board, there are formed for this purpose in the intermediate part 15 a number of apertures 16 to which π-filters or feedthrough-filter capacitors can be soldered, via which the circuit to be shielded is connected to the rest of the printed circuit board. The dimensions of the end wall can be selected freely, but it is advantageous to aim at small dimensions. In this case it is advantageous to select as the height of the step-shaped profile, i.e. as the height of the end wall 15, the same dimension as is the dimension, from the surface of the printed circuit board pc, of the highest component of the circuit to be protected. The width of the flange 12 is selected so that reliable soldering will be possible, and the projections of the flange 13 and the end flanges 14 are selected so that they will extend over some distance to the inside of the housing 1. The step-shaped profile which constitutes the end part of the shielding structure can be formed by bending from one single sheet-metal blank.

The second part of the shielding structure is a housing 1 which has a cover 5 and three sides abutting it. The structure of the sides is shown in Figures 1 and 3. Side parts 7, 7', 7" are approximately perpendicular to the plane of the cover and abut it. These side parts shield from the side the components to be shielded, as shown in Figure 3. The height of these side parts corresponds to the dimension of the highest component from the surface of the printed circuit board. The other side parts consist of successive bends 8, 9, 11; 8', 9', 11'; 8", 9", 11". By means of these bends, an inside groove is formed on three sides of the housing. The groove is dimensioned so that the edge of the printed circuit board fits suitably to move in the groove. In the cover 5 there is formed close to its open side a ridge or groove 3 parallel to this side edge, the groove being intended to engage the corresponding groove or ridge 4 in the flange 13 of the end wall 2.

The shielding method according to the invention is described briefly, still referring to Figure 1: When the printed circuit board is being cut to shape with a miller, the nec ssary number of slots U are cut. The end wall 2, in the apertures 16 of which filters are soldered, is attached for xample by soldering on the printed circuit board in th compon nt installing phas .

The housing 1 is pushed into the slots U so that th printed circuit board ar a between them comes inside the housing and the edges f the printed circuit board som in the inside grooves of the housing 1. When the pushing is continued, the flange 13 and end flanges 14 of th nd wall come inside the housing 1, against the

cover 5 and th sides 7, 7'. Since the material is elastic and th flanges 13 and 14 have be n suitably bent, they will come tightly against the inner surfaces of the housing 5. At the end of th pushing mov ment the groove 4 f th flange 14 engages th ridge 3 in the cover 5, locking the parts to each other. No ther fastening is n ed d.

When necessary, the housing 1 can easily be detached and reattached.

Figure 3 shows a cross section of the shielding housing installed on a printed circuit board pc. The figure illustrates how, when the housing 1 is being pushed into the slots cut in the printed circuit board, the edges of the printed circuit board in the area to be protected come into the grooves formed on the inner walls of the shielding housing, the grooves being limited by wall parts 8, 9, 11; 8', 9', 11'. The cover 5 of the housing may bear, in accordance with the figure, on the upper surfaces of the components K. If there is a risk of short circuit because of this, the risk of short circuit can be eliminated by coating the inside of the cover 5 entirely or in part with a suitable insulating material.

The housing 1 can be manufactured by any known technology, for example, by pressure forming from sheet metal.

Figures 1-3 show a shielding housing in which the flange-like parts 11, 11', 11" of the wall parts forming the inside grooves are rather narrow, extending over only a small distance inward on the lower surface of the printed circuit board. This suffices, if the lower surface of the printed circuit board is a continuous ground plane, which serves as a shield from this direction. If this is not the case, the lower surface can be shielded by making the flange-like parts 11, 11' so wide that they in part overlap, whereby a continuous metal shield is formed also on the lower surface of the printed circuit board. Alternatively it is possible to use a separate metal sheet the width of which is equal to the distance of the slots U from each other, in which case, when the housing is pushed into the grooves, this metal sheet is placed against the lower surface of the printed circuit board, whereupon it is left, in the installed state, to be supported by the flange-like parts 11, 11', 11".

Above, a case is described in which in a printed circuit board there are cut slots into which the shielding housing is pushed. It is clear that if the printed circuit area to be shielded is within a corner area of the board, only one slot is needed, in which case the printed circuit board edge abutting this slot and the outer edges of the board will push into the grooves inside the housing. It is also possible to cover the entire printed circuit board with a housing according to the invention, in which case the outer edges of the printed circuit board will push into the inside grooves of the housing. It is further possible to protect desired parts on the printed circuit board by cutting slots and by pushing the shielding housing into the slots, as described above, and finally to shield the entire printed circuit board with one housing covering it.

The structure according to the invention enables a very thin shielding housing material to be used, in which case the parts 1 and 2 of the shielding housing can be made, for example, from a spring bronze of 0.1-0.2 mm. The structure is light in weight, simple, and easy to attach and detach. Since it can be made low, it takes only little space. A good and tight shield is accomplished in each direction. The structure is usable wherever EMI-shielding is required, for example in paging devices, radio telephones, televisions, etc.

Claims

1. A shielding housing for shielding a printed circuit board, or a part of it, from disturbances caused by electromagnetic interference (EMI), made up of:
a first part (2) which constitutes one separate shielding-housing end, the cross section of which is approximately a step-shaped profile and the ends of which have flanges (14) projecting perpendicularly from the center part (15) of the step-shaped profile, a second part (1) having a cover (5) and three sides abutting it and being at an angle to it, there being formed by means of successive bends (8, 9, 11; 8', 9', 11'; 8", 9", 11") at those edges of the sides which are opposite in relation to the cover a flange-like inside groove the width of which corresponds to the thickness of the printed circuit board (pc), and in the cover (5) there is formed close to the open side a groove or ridge (3) parallel to it.

2. A shielding housing according to Claim 1, whereby in the middle part (15) of the step-shaped profile of the first part (2) there are apertures (16) to which filters can be attached for connecting the circuit to be protect d to the rest of the printed circuit board.

3. A shielding housing according to Claim 2, whereby in one flange (12) of th step-shap d profil there are made apertures (17) for facilitating its soldering to the printed circuit board and in the ther flange (13) there is formed a ridge or groove (4) running in the longitudinal direction of th flang .

4. A shield housing according to Claim 3, whereby from the nds of one flange (12) of the step-shaped profile th re project, perpendicularly from the flange, tabs (18) which are intend d for aligning the first part (2) with apertures in the printed circuit board.

5. A shielding housing according to Claim 1, whereby in that the lower edges (11, 11', 11") of the side walls of the second part (1) of the shielding housing are bent in the orientation of the lower surface of the printed circuit board so that they partly overlap, whereby a continuous metal shield is formed on the lower surface of the printed circuit area to be shielded.

6. A method for shielding a printed circuit board, or a part of it, from disturbances caused by electromagnetic interference (EMI), wherein the printed circuit board or its part is encased in a shielding housing which is in accordance with any of the above claims, whereby:
in the printed circuit board (pc) there are cut, starting from the edge, one or several slots (U) through the board, the slots extending to a distance (L), determined by the area to be shielded, from the edge of the printed circuit board; the first part (2) of the shielding housing of the printed circuit board is fastened by one flange (12) of the step-shaped profile; the second part (1) of the shielding housing is slipped over the printed circuit board in such a manner that the printed circuit part between the slots (U) cut in the printed circuit board, or the printed circuit part between the cut slot and the printed circuit board edge, will be left on the inside of the side walls (7, 7', 7") of the second part of the shielding housing and will bear on the flange-like grooves formed in the side walls, whereupon the flange (13) and the end flanges (14) of the first part (2) of the shield, attached to the printed circuit board, will come tightly against the inside surface of the second part (1) and the groove (4) is locked in a ridge (3) in the cover (5).

7. A method according to Claim 6, whereby the slots (U) through the printed circuit board are cut during the same process as the printed circuit board (pc) is cut into shape by using a miller.

8. A method according to Claim 6, whereby the lower side of the printed circuit board is shielded using a separate metal or metallized sheet which attaches by its edges between a bend (11, 11', 11"), parallel to the lower surface of the printed circuit board, of the side wall grooves of the second part (1) of the shielding housing and the printed circuit board.

Patentansprüche

1. Abschirmgehäuse zum Abschirmen einer (gedruckten) Leiterplatte oder eines Teils derselben vor durch elektromagnetische Einstreuung (EMI) verursachten Störungen, umfassend:
ein erstes Gehäuseteil (2), das ein getrenntes Abschirmgehäuseende darstellt, dessen Querschnitt etwa stufenförmig ist und dessen Enden Flansche (14) aufweisen, die vom Mittelteil (15) des stufenförmigen Profils senkrecht abgehen, ein zweites Teil (1) mit einem Deckel (5) und drei daran anstoßenden (anschließenden) und unter einem Winkel dazu angeordneten Seiten, wobei durch aufeinander folgende Biegungen (8, 9, 11; 8', 9', 11'; 8", 9", 11") an den Rändern der Seiten, die in bezug auf den Deckel gegenüber liegen, eine flanschartige Innennut gebildet ist, deren Breite der Dicke der (gedruckten) Leiterplatte (pc) entspricht, und im Deckel 85) nahe an der offenen Seite eine Rille oder ein Steg (3) parallel dazu geformt ist.

2. Abschirmgehäuse nach Anspruch 1, wobei im Mittel teil (15) des stufenförmigen Profils des ersten Teils (2) Öffnungen (16) vorgesehen sind, an denen Filter zum Verbinden der zu schützenden Schaltung mit dem Rest der (gedruckten) Leiterplatte anbringbar sind.

3. Abschirmgehäuse nach Anspruch 2, wobei im einen Flansch (12) des stufenförmigen Profils Öffnungen (17) zur Erleichterung seines Anlötens an der (gedruckten) Leiterplatte ausgebildet sind un im anderen Flansch (13) ein Steg oder eine Rille (4), der bzw. die in der Längsrichtung des Flansches verläuft, geformt ist.

4. Abschirmgehäus nach Anspruch 3, wobei von den Enden d s inen Flansches (12) des stufenförmigen Profils senkrecht zum Flansch Laschen (18) absteh n, die zum Ausrichten des ersten Teils (2) auf Öffnungen in der (gedruckt n) Leiterplatt vorgesehen sind.

5. Abschirmgehäuse nach Anspruch 1, wobei die Unterkanten (11, 11', 11") der Seitenwänd des zweiten

Teils (1) des Abschirmgehäuses in der Orientierung der Unterseite der (gedruckten) Leiterplatte, so daß sie (diese) teilweis überlappen, abgebog n sind, so daß an der Unterseite der zu schützenden Fläche der (g druckten) Leiterplatte ein durchgehende M tallabschirmung geformt ist.

6. Verfahren zum Abschirmen einer (gedruckten) Leiterplatte oder eines Teils derselben vor durch elektromagnetische Einstreuung (EMI) verursachten Störungen, bei welchem die (gedruckte) Leiterplatte oder ihr Teil in einem Abschirmgehäuse nach einem der vorangehenden Ansprüche eingeschlossen wird, wobei:

in der (gedruckten) Leiterplatte (pc), ausgehend von der einen Kante, ein oder mehrere Schlitze (U) durch die Leiterplatte hindurch eingestochen werden, welche Schlitze über eine durch die abzuschirmende Fläche bestimmte Länge (L) von der Kante der (gedruckten) Leiterplatte aus verlaufen; das erste Teil (2) des Abschirmgehäuses der (gedruckten) Leiterplatte mit einem Flansch (12) des stufenförmigen Profils befestigt wird; das zweite Teil (1) des Abschirmgehäuses derart über die (gedruckte) Leiterplatte gestülpt wird, daß der (gedruckte) Schaltungsteil zwischen den in die (gedruckte) Leiterplatte eingestochenen Schlitzen (U) oder der (gedruckte) Schaltungsteil zwischen dem eingestochenen Schlitz und der Kante der (gedruckten) Leiterplatte an der Innenseite der Seitenwände (7, 7', 7") des zweiten Teils des Abschirmgehäuses verbleibt und sich an die in den Seitenwänden geformten flanschartigen Nuten anlegt, woraufhin der Flansch (13) und die Endflansche (14) des an der (gedruckten) Leiterplatte angebrachten ersten Teils (2) der Abschirmung sich fest an die Innenfläche des zweiten Teils (1) anlegen und die Rille (4) in bzw. an einem Steg (3) im Deckel (5) verriegelt wird.

7. Verfahren nach Anspruch 6, wobei die die (gedruckte) Leiterplatte durchsetzenden Schlitze (U) im gleichen Vorgang, in welchem die (gedruckte) Leiterplatte (pc) in ihre Form geschnitten wird, mittels eines Fräsers eingestochen werden.

8. Verfahren nach Anspruch 6, wobei die Unterseite der (gedruckten) Leiterplatte mittels einer getrennten Metallfolie oder metallisierten Folie abgeschirmt wird, die mit ihren Rändern zwischen eine parallel zur Unterseite der (gedruckten) Leiterplatte liegende Biegung (11, 11', 11") der Seitenwand-Nuten des ersten Teils (1) des Abschirmgehäuses und die (gedruckte) Leiterplatte eingreift.

Revendications

1. Boîtier de blindage pour protéger par blindage une carte de circuit imprimé, ou une partie de cette carte, des perturbations provoquées par une interférence électromagnétique (EMI), constitué de:

une première partie (2) qui constitue une extrémité distincte du boîtier de blindage, dont la section transversale a approximativement un profil en forme de marche et dont les extrémités présentent des rebords (14) qui se projettent perpendiculairement depuis la partie centrale (15) du profil en forme de marche ; une seconde partie (1) présentant un couvercle (5) et trois côtés aboutissant à lui et formant un certain angle par rapport à lui, là étant formés, au moyen de plis successifs (8, 9, 11 ; 8', 9', 11'; 8", 9", 11") aux bordures des côtés qui sont opposés par rapport au couvercle, une rainure intérieure en forme de bride dont la largeur correspond à l'épaisseur de la carte de circuit imprimé (pc) et dans le couvercle (5) est formée, près du côté ouvert, une rainure ou une nervure (3) parallèle à ce côté.

2. Boîtier de blindage selon la revendication 1, dans lequel, dans la partie médiane (15) du profil en forme de marche de la première partie (2) se trouvent des ouvertures (16) auxquelles on peut fixer des filtres pour relier le circuit à protéger au reste de la carte de circuit imprimé.

3. Boîtier de blindage selon la revendication 2, dans lequel, dans l'une des contre-marches (12) du profil en forme de marche sont faites des ouvertures (17) pour faciliter son brasage sur la carte de circuit imprimé et, dans l'autre contre-marche (13) est formée une nervure ou rainure (4) orientée selon la direction longitudinale de la contre-marche.

4. Boîti r de blindage s lon la revendication 3, dans l quel, depuis les extrémités de l'une des contre-marches (12) du profil en forme de marche se projettent, perpendiculairem nt à la contre-marche, des pattes (18) prévues pour aligner la première partie (2) avec des ouvertur s dans la carte de circuit imprimé.

5. Boîtier de blindage selon la rev ndication 1, dans lequ l les bords inférieurs (11, 11', 11") d s parois la-

térales de la seconde partie (1) du boîtier de blindage sont pliés selon l'orientation de la surface inférieure de la carte de circuit imprimé de façon à se recouvrir partiellement, c par quoi un blindage métallique continu est formé sur la surface inférieure de la carte de circuit imprimé à protéger par blindage.

6. Procédé pour protéger par blindage une carte de circuit imprimé, ou une partie de cette carte, des perturbations provoquées par une interférence électromagnétique (EMI), dans lequel la carte de circuit imprimé, ou sa partie, est emboîtée dans un boîtier de blindage conforme à l'une quelconque des revendications précédentes, procédé dans lequel:

dans la carte de circuit imprimé (pc) on découpe, en partant du bord, une ou plusieurs fentes (U) à travers la carte, les fentes s'étendant sur une distance (L) déterminée par la zone à protéger par blindage, depuis le bord de la carte de circuit imprimé; la première partie (2) du boîtier de blindage de la carte de circuit imprimé est fixée par une contre-marche (12) du profil en forme de marche; la seconde partie (1) du boîtier de blindage se glisse par-dessus la carte de circuit imprimé de façon que la partie de la carte de circuit imprimé qui se trouve entre les fentes (U) découpées dans la carte de circuit imprimé, ou la partie de la carte de circuit imprimé qui se trouve entre la fente découpée et le bord de la carte de circuit imprimé, va rester à l'intérieur des parois latérales (7, 7', 7") de la seconde partie du boîtier de blindage et va porter sur les rainures en forme de brides formées dans la parois latérales, sur quoi la contre-marche et les rebords d'extrémité (14) de la première partie (2) du blindage, fixés à la carte de circuit imprimé, vont venir se serrer contre la surface intérieure de la seconde partie (1) et la rainure (4) va se verrouiller dans une nervure (3) prévue dans le couvercle (5).

7. Procédé selon la revendication 6, dans lequel on découpe les fentes (U) traversant la carte de circuit imprimé au cours du même processus que la découpe de la carte de circuit imprimé (pc) pour la mettre en forme à l'aide d'une fraiseuse.

8. Procédé selon la revendication 6, dans lequel on blinde la face inférieure de la carte de circuit imprimé à l'aide d'une feuille de métal ou métallisée, distincte, qui s'attache, par ses bords, entre un pli (11, 11', 11"), parallèle à la surface inférieure de la carte de circuit imprimé, des rainures de la paroi latérale de la seconde partie (1) du boîtier de blindage et la carte de circuit imprimé.

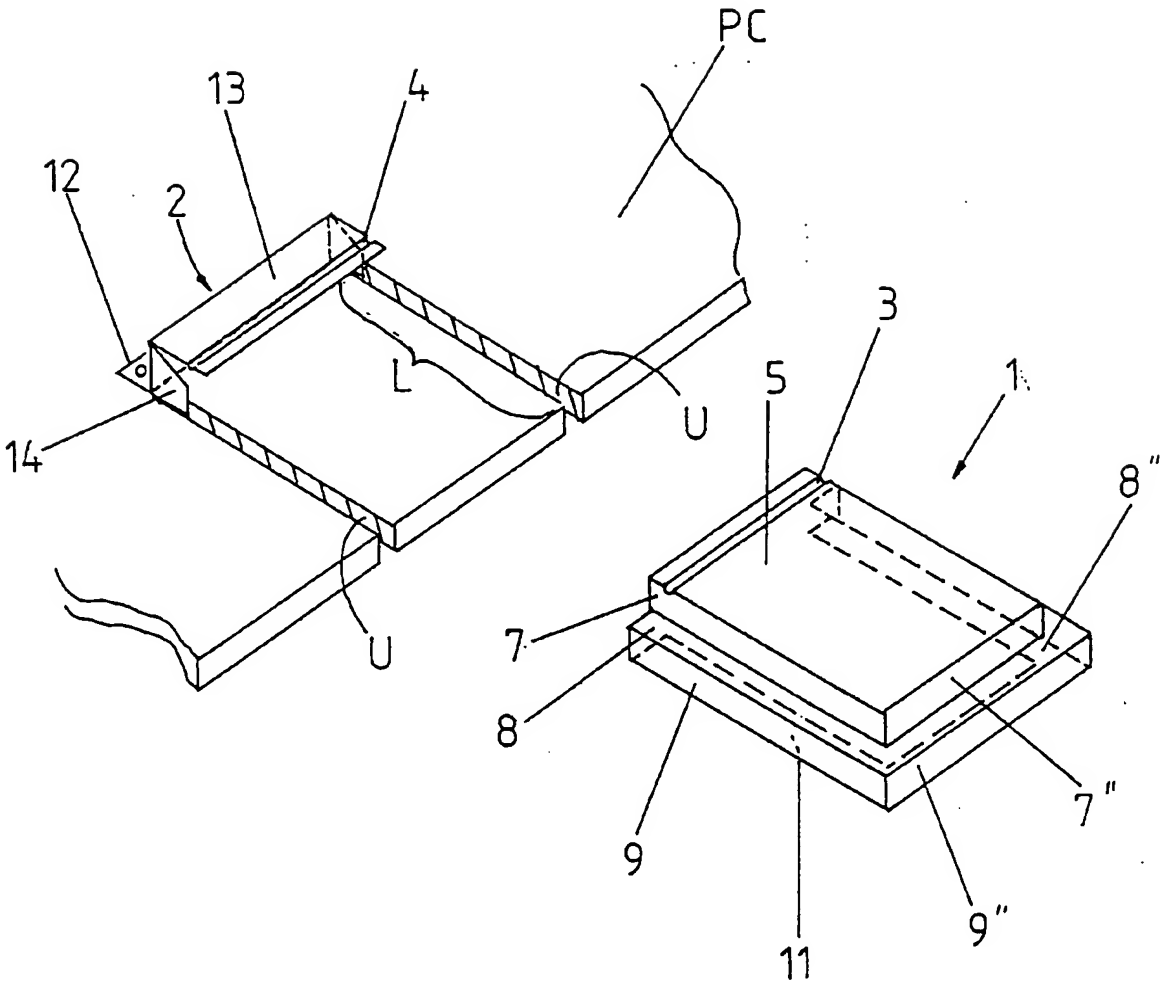

FIG. 1

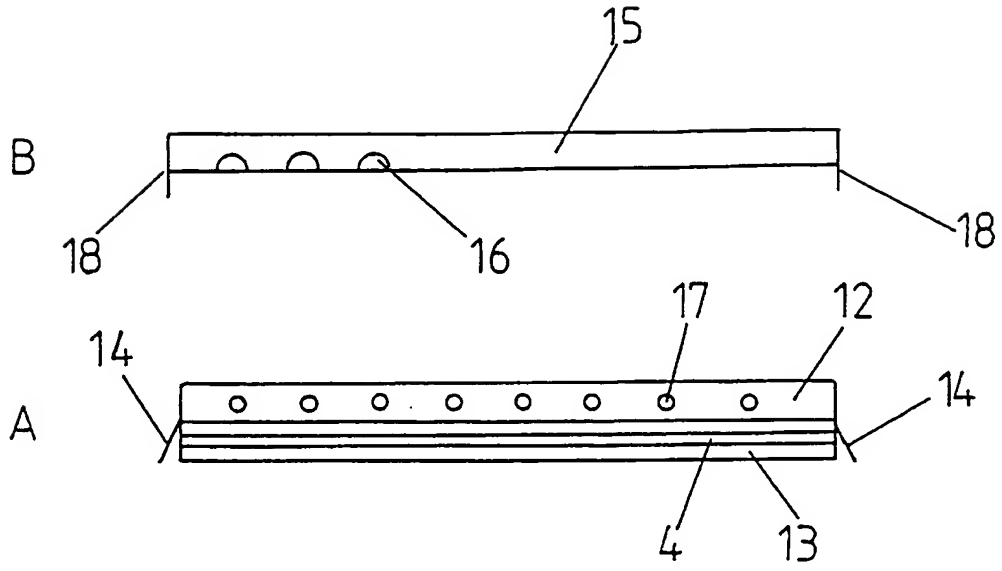

FIG. 2

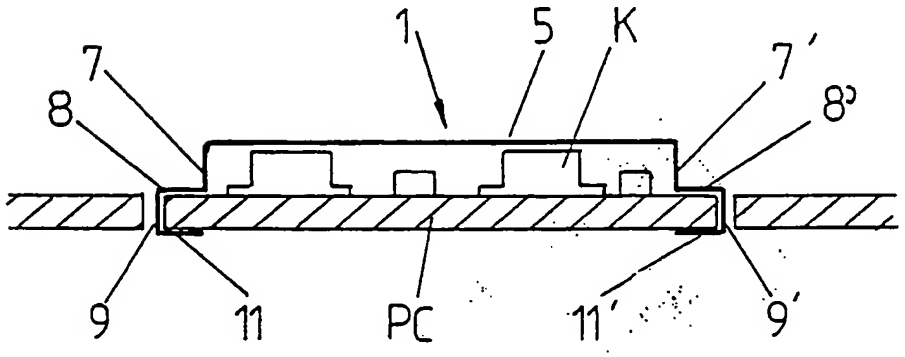

FIG. 3